THE INSECTS DESTRUCTIVE TO FRUITS

BY

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EDITOR'S PREFACE TO THE TWENTY-FIRST EDITION.

PROBABLY no other work of its character has enjoyed the popularity of Thomas' "American Fruit Culturist"; first published many years ago. It has, unlike most books by other authors, been revised and kept up to date, both with respect to the newer varieties of fruits and also the improvements in cultivation—in all the details, in fact, pertaining to the science and art of fruit growing. In the preparation of the present edition the editor has had the valued assistance of Prof. M. V. Slingerland of Cornell University, who wrote the chapter on Destructive Insects; of Prof. Byron S. Halsted of Rutgers College, who wrote that on Diseases of Fruits; and especially of Prof. L. H. Bailey, who supervised almost the entire book.

The editor still feels that the time has not yet come to adopt absolutely the rule of the American Pomological Society with respect to the names of fruits. To do so before the nurserymen, the dealers, much more generally conform to it could only lead, as before stated, to uncertainty and confusion. Thomas' "Fruit Culturist" has again been materially enlarged both in text and illustrations.

While it is believed that this book will be found scientifically accurate, it must be remembered that it is prepared especially as a practical working manual for the amateur and farmer.

WILLIAM H. S. WOOD.

NEW YORK, *February, 1903.*

CHAPTER XII.

DESTRUCTIVE INSECTS.

INSECTS are among the most formidable enemies to successful fruit-culture. The losses occasioned by the plum curculio alone amount to more than a million of dollars annually. Orchardists are sometimes deterred, by the attacks of this insect, from attempts to raise the apricot, nectarine, peach, and plum; and the market supply of apples and pears is often much disfigured by it. The apple-worm, or codling-moth, is even a more formidable insect pest. New York fruit-growers alone yearly furnish $2,500,000 worth of apples and $500,000 worth of pears to feed this insect; and other similar apple-growing States report nearly as large an annual loss from its ravages. The depredations of many other insect pests, like the apple-tree and the peach-tree borers, the canker-worms, the tent-caterpillars, the apple maggot, and the pear psylla, each causes annual losses amounting to several hundred thousand dollars.

As a general rule those remedial measures are of little value, which attempt merely to repel insects without destroying them. Experiments show that rarely is an insect repelled from attacking any part of a plant by the application of odorous substances, like carbolic acid, tar, etc.

How insects eat.—Another very important fact which fruit-growers must understand is that all insects do not eat in the same manner. Many, like the currant worms or the plum curculio, have two pairs of horny jaws, which they work from side to side and bite off or chew and swallow solid particles of their food; while several of our worst fruit-pests, like the scale-insects or pear psylla, have mouth-parts built on an entirely different plan. Their jaws are modified into long, fine

bristles which are worked along a groove in a supporting beak or elongated lower lip. These insects place the point of this beak on the surface of the plant, force the bristles into the tissue, and then, by the help of a muscular box in the throat, they draw or suck up along the beak the liquid juices from the interior of the plant.

One can readily see how the biting or chewing insects are killed by putting a poisonous powder or spray on the surface of the plant attacked; particles of the poison would be taken into the body with the solid food in eating. But a sucking insect can eat only liquid food, which it gets from the interior of the plant; hence it could not eat a poison put upon the surface. And as it is not possible to poison the internal tissues or juices, one is forced to use something besides poisons to kill sucking insects. They can be killed by suffocating them with a gas, like hydrocyanic acid gas, or with a powder, like pyrethrum, which stops up their breathing-holes, or with some liquid, like kerosene or a soap solution, which kills by soaking into their body or in the same way as the powders. Many pounds of Paris green have been wasted in trying to feed it to sucking insects.

Fruit-growers can readily determine if an insect is chewing or sucking its food. If of the former class, then aim a poison spray at the part of the plant where it is feeding; but if it is a sucking insect, then aim an oil or soap spray at the insect itself.

There are a hundred or more different kinds of injurious insects, and equally as many diseases, which sometimes seriously interfere with the growing of a profitable crop of fruit. Most of the serious or standard insect pests and the more common diseases which are met with by the fruit-grower will be found treated of in this chapter; the others which occur less frequently, or become serious in their effects in restricted localities, it has not been considered necessary to treat of here. In all such cases advice should immediately be sought from the State Agricultural Experiment Station. (For list see chapter xvi.)

In previous editions of this work no logical plan was followed in discussing the destructive insects. We have thought it advisable to change this and first discuss the apple pests,

beginning with those affecting the roots, then the trunk and bark depredators, following with those feeding on the buds and leaves, and finally discussing those which infest the fruit. The insects which affect the pear, plum, peach, cherry, quince, grape-vine, currant and gooseberry, raspberry and blackberry, and strawberry will be discussed in the order in which they are named, and in each case the method outlined for the apple insects will be followed.

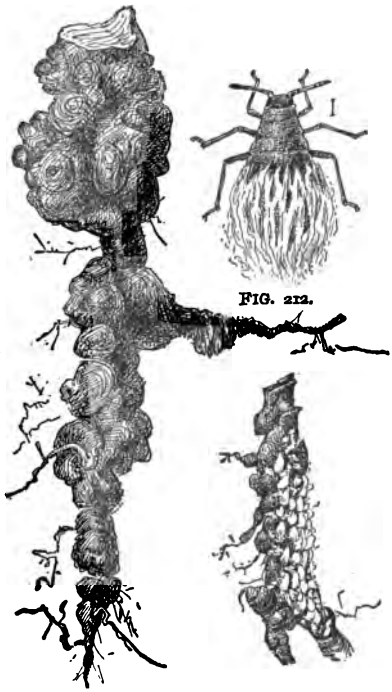


FIG. 212.

FIG. 210. FIG. 211.

The Woolly Aphis.

FIG. 210.—Root illustrating deformation by the aphis. FIG. 211.—Portion of root with aphids on it. FIG. 212.—The Root Louse, female. Figs. 210 and 211 natural size; Fig. 212 much enlarged. (U. S. Div. of Entomology.)

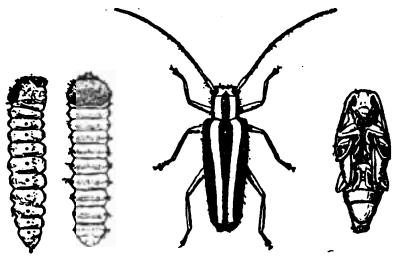
The Woolly Aphis (*Schizoneura lanigera*).—This reddish-brown plant-louse, covered with a flocculent waxy secretion (Figs. 211 and 212) works both on the roots, where it forms knotty enlargements (Fig. 210), and on the branches, where it causes roughened scars. It attacks the apple only, and some varieties, the Northern Spy, for instance, are quite immune from it. Nursery stock and young trees are often seriously damaged, while in most parts of the country well-established bearing trees are rarely noticeably injured. It has quite a complicated life-history. Most of the lice are wingless, but in the fall many winged forms appear, and these are one of the means by which the insect is spread. It is also widely distributed on nursery stock.

The aërial or branch form of the insect does little injury,

and is easily killed with kerosene emulsion, a strong soap solution, or a tobacco decoction applied in a forceful spray. The root form is much more difficult to reach. Badly infested nursery stock should be destroyed. The roots of slightly affected stock should be dipped for a few seconds in water kept at a temperature of 130 to 150 F., or in a warm, strong soap solution, before it is planted. Recent experiments show that finely-ground tobacco dust is very effective if placed in a small furrow along either side of nursery rows or distributed at the rate of from two to five pounds per tree for a distance of two feet from the crown, after first removing from four to six inches of soil. The tobacco dust is cheap, and has considerable fertilizing value.

The Round-Headed Apple-Tree Borer (*Saperda candida*). —This insect enters the tree and burrows into the solid wood near the surface of the earth. It is a dangerous enemy; for while only a few small holes are visible in the bark outside, it may have perforated the wood internally in all directions.

Not only the apple-tree, but the quince, mountain-ash, and hawthorn suffer greatly from the attacks of this insect.



FIGS. 213 and 214. FIG. 215. FIG. 216.

The Round-headed Apple-tree Borer.

FIGS. 213 and 214.—The grub. FIG. 215.—The beetle. FIG. 216.—The pupa. All natural size. (U. S. Div. of Entomology.)

The parent insect is a beautiful, brown-and-white striped beetle (Fig. 215), about three-fourths of an inch long, which flies at night. It deposits its eggs in June and later in slits cut in the bark, usually near the surface of the ground. The egg-stage is said to last about twenty days. The first indication of the work of the larva is the appearance of a small round hole, made visible by the ejected dust.

The young larvæ tunnel under the bark and feed upon the sapwood, gradually working their way upward and afterward downward. During the second season the larvæ attain about

half their growth, still living on the sap-wood. They cease feeding during the winter and remain in their burrows beneath the surface of the soil. By the end of the second year they have penetrated deeper into the solid heart-wood, and their burrows are closely packed behind them with their castings. After another winter's rest they continue their work in the solid wood, and toward the end of the season gnaw outward to the bark. With the aid of its castings a cell is then formed in which the full-grown larva (Figs. 213 and 214) remains until spring, when it transforms to a pupa (Fig. 216). The pupal stage is said to last about twenty days, and in May or June the pretty beetles emerge through a smooth, round hole cut with their powerful jaws.

This borer is a very difficult insect to control. It is nearly impossible to save a young tree. When small, the larva may be cut out with the point of a knife. If deeper in the wood, it may be extracted or punched to death in its hole with a flexible wire.

It will avail nothing to inject any substance into the large round holes made by the beetles in emerging from the tree. But it is reported that if kerosene be applied wherever the castings of the larva are seen sticking through the bark, the oil will permeate the burrow and kill the larva.

Some have successfully destroyed similar borers in their burrow by injecting carbon bisulphide from an oil-can into the openings from which castings are protruding and then plugging the hole with putty or hard soap; the deadly fumes of this liquid penetrate all through the burrow and quickly kill the borers. It is a difficult matter to prevent this borer from getting into a tree. Several thicknesses of newspaper or tarred paper carefully wrapped about the base of the tree and tied often forms quite an effective barrier. The many different washes recommended afford but little protection in our experience. Examine the trees twice each year, in May and September, and dig out or destroy all larvæ which can be located. Clean culture will help in the warfare against borers.

The Flat-headed Apple-tree Borer (*Chrysobothris femorata*).—This is usually a much less dangerous, though more abundant, insect than the preceding species. The pretty beetles (Fig. 218) are day-fliers. They attack by preference

sickly trees; they inhabit both the trunk and limbs of a tree, and, besides apple, pear, peach, and apricot trees, they also attack a variety of forest trees. They are chiefly injurious to young trees.

The eggs are laid in crevices of the bark, and the larvæ (Fig. 217) get their growth in one year, living mostly just beneath the bark. The pupal stage (Fig. 220), lasting about three weeks, is passed in a cell made in the solid wood. The beetles emerge in May and June through elliptical-shaped holes.

Trees badly infested with this borer should be burned at once. The remedial measures advised for the round-headed borer may also be applied against the flat-headed species.

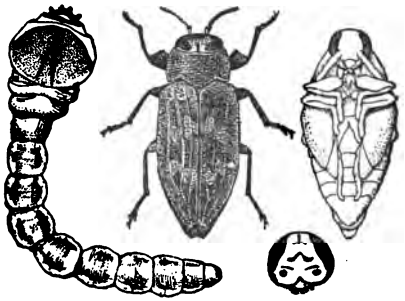


FIG. 217. FIG. 218. FIG. 219. FIG. 220.
The Flat-headed Apple-tree Borer.
FIG. 217.—Larva or grub. FIG. 218.—Beetle. FIG. 220.—Pupa. All twice natural size. (U. S. Div. of Entomology.)

SCALE-INSECTS are minute sucking insects, which now rank among the most destructive fruit pests in many parts of the country. We can here discuss only a few of the more common ones.

The Oyster-shell Bark-louse (*Mytilaspis pomorum*).—This scale (Fig. 222) is very common on apple-trees all over the country; it also attacks many forest trees, and it is found all over the world. It is shaped somewhat like an oyster-shell, and is nearly the color of the apple bark. In northern latitudes there is but a single annual generation of the insect; in the South there are two. It usually confines its attacks to the bark of younger branches, but sometimes occurs on the fruit in the North.

If the scale be tipped over during the winter, it will present the appearance seen at *a* in Fig. 221; that is, the shrivelled body of the female is tucked away at one end, and from 30 to 90 white eggs occupy the rest of the scale. The winter is passed in the egg, and the young lice usually hatch in the

latter part of May. They travel about over the bark for a few hours, and when a suitable place is found to insert their beak, they begin feeding, and never move from the spot during the rest of their life. They soon begin to secrete the scaly covering, which gradually increases in size with the growth of the tender body of the insect underneath. When fully grown early in the fall, the female deposits her quota of eggs under the scale and dies. The male insect is provided with wings, and is developed under a much smaller scale (Fig. 222, *d*). The old scales may remain on the bark for a year or more, and oftentimes the living scales may be so numerous as nearly to cover the bark, as shown in *c* in Fig. 223. Young trees are often much weakened from its attacks, but it rarely kills apple-trees.

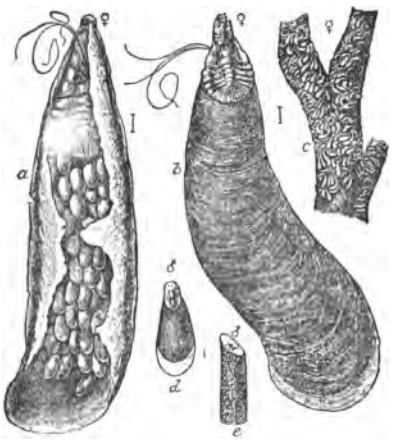


FIG. 221. FIGS. 222 and 223.

The Oyster-shell Bark louse.

FIG. 221.—Female scale from below, showing eggs. FIG. 222.—The same from above, greatly enlarged; *d*, male scale, enlarged. FIG. 223 Female scales. (U. S. Div. of Entomology.)

One should scrape off all of the scales practicable when the tree is dormant, thus removing the eggs, which are difficult to reach and kill with any wash. Then wait until about May 15th, or as soon as the young lice can be seen crawling on the bark, and drench the bark with kerosene emulsion, or a whale-oil soap solution of one pound in five gallons of water, or use a kerosene-water pump with ten per cent. of kerosene. A second application may be necessary a week or ten days later.

The Scurfy Bark-louse (*Chionaspis furfurus*) is another scale very commonly met with in orchards, especially on apple and pear-trees. As shown in Fig. 224, it is shaped somewhat like the oyster-shell bark-louse, and has a similar life-history, but

its scaly covering is nearly white in color. It is two-brooded even in New York, and from ten to seventy-five purple eggs winter under each female scale.

This scurfy scale is best controlled by the same methods as the preceding species.

San José Scale (*Aspidiotus perniciosus*), Fig. 229.—This insect first appeared in California many years ago. About 1887 it was introduced into the Eastern United States on nursery stock; and it has since attained international importance, and has been widely distributed throughout this country. It is recognized everywhere as a most destructive and dangerous fruit pest. It spreads all over the tree and fruit, at times literally covering it—in such cases often killing it, if undisturbed, in a few years. It thrives on all kinds of fruit-trees, and on the small fruits as well as on most other deciduous trees or shrubs; peaches usually succumb to its attacks more quickly than any other fruit-trees.

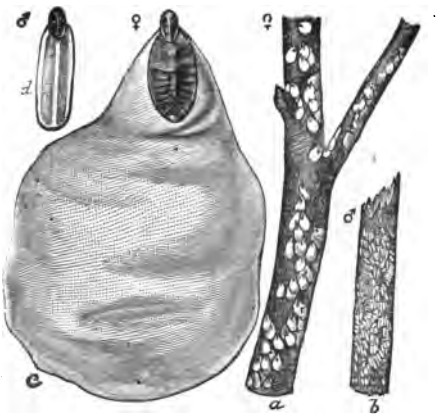


FIG 224 FIG. 225. FIG. 226.
The Scurfy Bark-louse.

FIG. 224.—*c*, Female; *d*, male. FIG. 225.—Female scales. FIG. 226.—Male scales. Figs. 225, 226, natural size; Fig. 224 enlarged. (U. S. Div. of Entomology.)

FIG. 227.—San José Scale. (Greatly magnified.)

It can spread only by direct contact of the living female with a live tree, either from the interlocking of the branches of an infested tree with others, or by being carried from one to another by birds or insects. Infested nursery stock is the most fertile source of distribution. While it is often found on the fruit, there is yet no definite evidence that such fruit was the source of any infestation.

The reason this scale is so much more dangerous than either of the two bark-lice just discussed is because of its greater

power of multiplication. The insect winters in the form of small round black scales scarcely larger than a pin's head. These become full grown in May or June, when they are of a grayish color and nearly an eighth of an inch in diameter. There is no egg stage, the young lice being born alive, and they may become mothers in about forty days. Thus there are from three to five generations of the scales during a season, and as one mother may rear from one hundred to five hundred

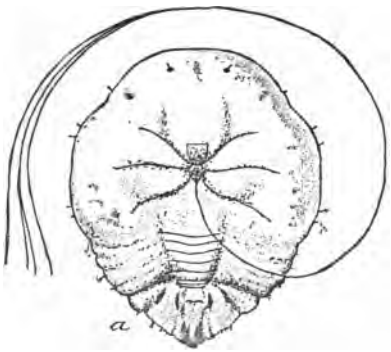


FIG. 228. FIG. 229

FIG. 228.—San José Scale.—Female insect which lives under the scale, greatly enlarged. (Adapted from Howard's figures.)
FIG. 229.—San José Scale, natural size.

young, it is easy to understand how a few scales may soon cover a tree with their progeny. If one of the scales be tipped over at any time, there will be found the soft, yellow body of the insect itself, as shown in Fig. 228.

Much legislation has been enacted to prevent the spread of or to exterminate this pernicious pest, and much good has resulted from the systems of inspection of nurseries and orchards, but eventually every fruit-grower will have to work out his own salvation. Fruit-growers should understand that the insect can never be exterminated in any seriously infested orchard or locality without destroying the trees, but it can be, and some are controlling it as effectually as they are some other fruit pests.

It can best be treated when the trees are dormant, but much

can be done also by spraying the trees several times during the growing season with a kerosene-water pump, using about 20 per cent. of kerosene, or with whale-oil soap, about one pound in four or five gallons of water. For a winter wash a solution of good whale-oil soap, two pounds in one gallon of water, has been found very effectual. Pure kerosene is also effective, but often injures the tree. Crude petroleum applied as a winter wash, in a 25 to 40-per-cent. mixture, with a kerosene-water pump, is also proving a valuable addition to the insecticidal batteries that may be directed against this pest. Very effective work has also been done in the East with the California wash of lime, sulphur, and salt.

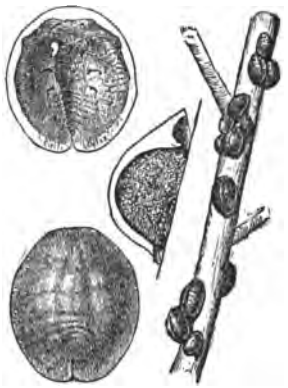


FIG. 230.—The Peach Lecanium Scale, natural size and enlarged.

Fumigation with hydrocyanic acid gas is the most perfect method of controlling the San José scale, but it requires expensive apparatus for orchard work. Nursery stock, however, can be cheaply fumigated, and when properly done, it will prove a great safeguard to the fruit-grower against, not only this scale, but many other injurious insects often sent out by nurserymen.

Lecanium Scales.—These are large, soft-shelled, brown scales about the size and shape of a half pea. There are many species, some of which, like the Black Scale of California, are very destructive. A few years ago one of these Lecaniums appeared in overwhelming numbers in several plum orchards in western New York, and many bearing trees were killed. Climatic conditions and its insect enemies, however, soon turned the tide, and the pest may remain in its former obscurity for many years.

Such scales can often be successfully controlled by spraying the trees when dormant with kerosene emulsion, one part to four of water; doubtless a kerosene-water pump, using 20 or 30 per cent. of kerosene, or whale-oil soap, one pound in two to four gallons of water, would prove equally effectual.

The Apple Aphis (*Aphis mali*) is the little green plant-louse which often appears in large numbers on the opening buds of apple in early spring. These hatch from shining black eggs laid on the bark in the fall. Usually but little damage is done by the lice on bearing trees, but in nurseries it often proves a serious pest by badly curling the leaves and checking the growth of the stock. Winged forms may leave the apple-tree and start a series of summer generations on June grass.

They may be destroyed by a solution of whale-oil soap, or even by common soap-suds. It may be applied with a spray pump; or young trees in the nursery and their branches may be bent over and immersed in the liquid contained in a large pail. It should be repeated as often as they reappear.

The Bud Moth (*Tmetocera ocellana*).—This insect does much damage in many sections of the country. A little brown caterpillar comes from a silken home, in which it hibernated, and proceeds to eat into the opening buds. It soon ruins the opening flowers and ties them and the leaves together into a nest, as shown in Fig. 232. The brown caterpillars get full grown in June, when they measure about half an inch in length, and then soon undergo their transformations to the adult insect, the moth, shown in Fig. 231. The moths soon lay their eggs on the leaves and the young caterpillars mine in the leaves until time to go into winter quarters in their silken homes on the branches near the buds.

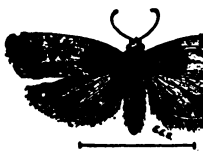


FIG. 231.—The Bud Moth, twice natural size.

FIG. 232.—Work of a bud moth caterpillar in an opening leaf bud, natural size.

It requires intelligent and persistent work with a Paris

green or other poisonous spray in the spring to control this serious pest; it is usually necessary to make two thorough applications before the blossoms open.

Canker-worms are among the most destructive of apple pests. They are measuring-worms from an inch to an inch and a half

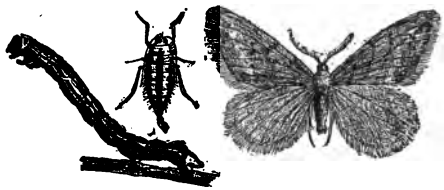


FIG. 233.—Spring Canker-worm.—Larva; female; male.

in length, and finally develop into small moths, the females of which (Fig. 233) have no wings. There are several different kinds of canker-worms, and they often work together in the same orchard. They consume the foliage, except the larger leaf veins, and give the trees a scorched appearance from a distance, so that the insects are known as "fire-worms" in some localities. We have seen thousands of acres of apple

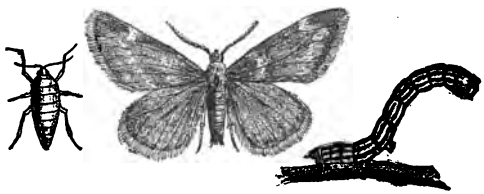


FIG. 234.—Fall Canker-worm.—Female; male; larva.

orchards in Western New York defoliated by these pests in a single season. They spread rather slowly from orchard to orchard.

In some localities the kind known as the fall canker-worm (*Anisopteryx pometaria*) (Fig. 234) is the most numerous, while in other sections the spring canker-worm (*Paleacrita vernata*) (Fig. 233) far outnumbers any others. At least two other kinds may also occur in injurious numbers; they are the lime-tree winter-moth *Hybernia tiliaria*, and Bruce's canker-worm *Rachela bruceata*.

The moths of the fall canker-worm and of the two last-named species emerge in the fall, while the spring canker-worm moths appear in March and April. In each case the wingless females have to crawl up the tree, where they lay their eggs on the bark. The eggs of each species hatch about the same time in the spring, as the leaves begin to unfold, and the caterpillars feed ravenously for about a month. They then disappear into the ground a short distance, where they transform to pupæ, finally to emerge as moths in the fall or spring.

Canker-worms are not difficult pests to control when one understands their habits, so that the warfare can be waged at the proper time. The caterpillars can be killed after they have begun work in the spring by thorough, honest efforts with a spray of Paris green or some similar poison at the rate of one pound in one hundred gallons of water or Bordeaux mixture. It will require several applications where the pests are very numerous, and it is all-important to apply the poison before the caterpillars get two-thirds grown; it always takes much less poison to kill a small caterpillar than one nearly full-grown.

Orchards which are well cultivated from year to year are rarely seriously infested with canker-worms. Doubtless many of the pupæ in the soil are destroyed by the cultivation.

As the female cannot fly, various expedients for preventing it from ascending the tree from the ground in the fall or early spring have been devised. Bands of sheathing-paper six or eight inches wide are often tacked around the trunks of the trees, and then smeared with tar, or any other sticky substance which will not lose its viscidity. Before putting on the bands smooth off the bark, so that there shall be no crevices under the paper through which the tiny moths may crawl.

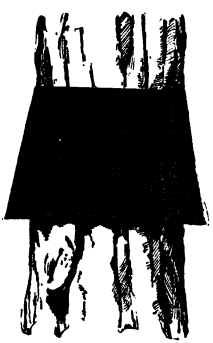


FIG. 235.—Common-sense Wire Trap for Canker-worms.

Another simple patented device, shown in Fig. 235, has been extensively and successfully used in Western New York. This Common-Sense Wire Trap, when properly put on and cared for while the

moths are ascending the trees, forms a simple, cheap, and very effective barrier. We have seen such a trap filled with the moths crowding and pushing each other until many of them were killed; in a badly infested orchard we have seen at least a thousand moths trying to ascend a single tree in one evening.

Tent-caterpillars are serious enemies to apple-trees and some forest trees in most parts of the country. They have their seasons of increase and decrease.

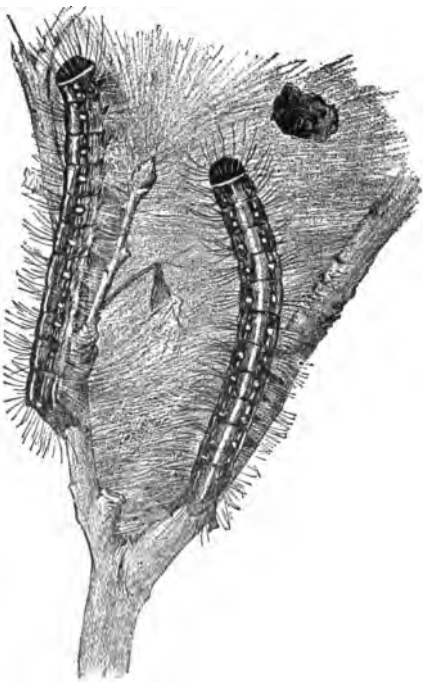


FIG. 236.—Apple-tree Tent-caterpillars on their Tent, natural size.

FIG. 237.—Egg-mass of Tent-caterpillar.

Some years they nearly strip whole orchards; and again they diminish in numbers in successive years, till few can be found.

The species which usually does the most damage to fruit-trees is shown in Fig. 236, and it is known as the American or *Apple-tree Tent-caterpillar* (*Clisiocampa americana*). In the spring, as soon as the leaf-buds of the apple begin to open, the little hairy caterpillars hatch from their varnished egg-ring (Fig. 237), where they have spent the preceding eight or nine months. They feed for five or six weeks and attain the size

shown in Fig. 236. Those we have watched fed mostly at night, early morning, or at midday. They are social caterpillars, and each family or colony lives together in a silken tent or nest, which they begin in a near-by crotch soon after they hatch, and gradually enlarge as they need larger quarters.

These tents or "signboards" are conspicuous objects in an

FIG. 238.--Female Moth of Apple-tree Tent-caterpillar on Cocoon, natural size.

FIG. 239.—A Forest Tent-caterpillar, natural size.

orchard. The tent serves as a home from which the caterpillars issue at feeding times and forage over the tree, spinning a silken thread wherever they go. When they get their growth early in June, they find some secluded cranny in a near-by fence or elsewhere and spin about themselves a coarse, white, silken cocoon intermixed with a yellow powder (Fig. 238). In this cocoon they change to pupæ, and finally transform to reddish-brown moths (Fig. 238) in about three weeks. The moths emerge and lay their peculiar rings of eggs (Fig. 237) around the smaller branches early in July; each egg-mass contains about two hundred eggs, which are covered by

a vesicular, water-proof varnish. There is thus but one brood of the caterpillars each year, and by far the largest portion of the insect's life is spent in the egg, usually from July until the following April.

Maple shade trees and sugar-bushes, as well as some other forest trees, sometimes suffer severely from hordes of large hairy caterpillars, which are closely allied to the apple-tree tent-caterpillar, and have been called the *Forest Tent-caterpillar* (*Clisioscampa disstria*). One of them is shown in Fig. 239. Sometimes this insect invades orchards and proves a more serious enemy than its near relative. Its life-history is practically the same as that of the apple-tree tent-caterpillar, but the two species are easily distinguished in the egg, caterpillar, and moth stages.

The egg-rings of the forest species are shorter and blunter at the ends; the caterpillars have a row of whitish spots down the middle of the back instead of a continuous white stripe; the moths have an oblique band of a deeper tint across each front wing, while those of the apple-tree tent-caterpillar are crossed by a similar band bordered with narrow white stripes. The popular name of forest tent-caterpillar is misleading, as the caterpillars do not make a tent, but simply spin a thin silken mat or carpet on the bark where the whole family rests when not feeding.

Several parasitic and predaceous insects prey upon this forest species and usually keep it in subjection. In sugar-bushes and other forest lands man must depend largely upon these enemies to control the pest.

The best and cheapest method of combating both the apple-tree and the forest species of these tent-caterpillars is to cut off the small branches which bear the eggs, during autumn or winter, and burn them ; do not leave them on the ground, for they will often hatch as readily there as on the tree. A most convenient implement for this work is a tree-pruner (see page 102). The eggs are seen at a glance after a little practice. Every ring of eggs thus removed, which is done in a few seconds, totally prevents a nest or colony of caterpillars in the spring, and is far more expeditious and effectual than the usual modes of burning the nests, or brushing off the caterpillars with poles at a later period. Enlist the

children in this work by prizes, or by paying a certain amount for the collection of unhatched egg-rings at any time between August 1st and the following April; this is especially applicable in villages where shade trees are infested.

Where orchards are thoroughly sprayed with poisons for other pests, the tent-caterpillars are usually destroyed at the same time.

The caterpillars of the forest species quickly drop from the tree when it is suddenly jarred, thus offering a very practicable method of collecting and killing them in orchards, and especially on village shade trees. When the apple-tree tent-

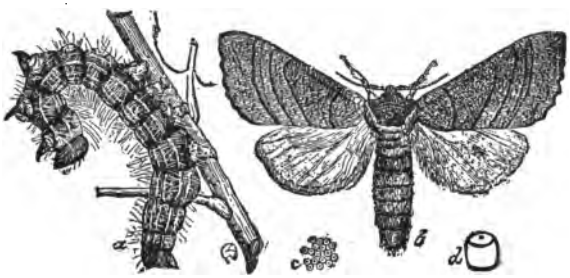


FIG. 240. FIG. 241.

caterpillars and their nests or "signboards" are small, a whole family can be quickly wiped out and destroyed with an old mitten or rag in one's hand. These nests should be looked upon as signboards of shiftlessness, for not many injurious insects can be so easily controlled.

Yellow-necked Apple-tree Caterpillar (*Datana ministra*).—The larva of this moth, which usually appears in July or August, when full grown, is from an inch and a half to two inches long. A family of them is so voracious that if undisturbed they will soon defoliate a small tree. Though they spin no web, they have a peculiar habit of collecting together in masses in the noticeable position shown in Fig. 240. At such times they may easily be destroyed by burning, or by brushing them off on to the ground and killing them. The perfect insect is shown in Fig. 241.

The Apple Maggot (*Trypeta pomonella*) Fig. 242, lives in the pulp of the apple and tunnels it in winding channels, ruin-

ning it except for feeding to stock. It is a footless maggot, one-fifth of an inch long, and changes to a pretty two-winged fly. It prefers the thin-skinned summer and fall apples to the winter varieties, but no varieties are exempt from attack. It has spread over the Eastern and Northern States, where it has become a very serious pest, and is sometimes called the "railroad worm."

The flies begin to appear early in summer and insert their eggs through the skin of the partially grown apples. The fact that the maggots rarely, if ever, leave the fruit while it remains on the tree affords practically the only vulnerable place in the insect's life. After the apple falls or is picked, the full-grown maggots crawl out and change to the pupal state in the ground, or in the receptacles in which the fruit may be stored. It hibernates in the pupal stage.

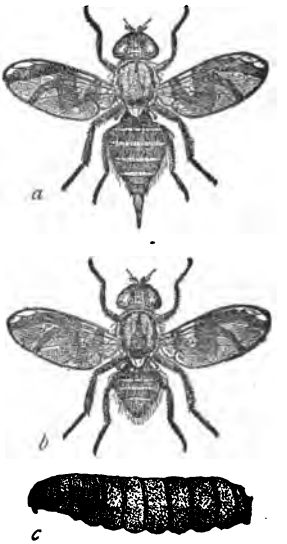


FIG. 242.—Apple Maggot —*a*, Female; *b*, male; *c*, maggot. (After Harvey.)

The insect is thus out of the reach of the spraying pump, and the most efficient remedy is to turn sheep or other stock into the orchard, which will devour the fruit as soon as it falls, or to pick up at once and feed out or bury deeply the fallen fruit in gardens.

The Apple-Worm or Codling-Moth (*Carpocapsa pomonella*).—This insect has become the most formidable enemy of the apple in the United States. It also does much damage to the pear, and rarely attacks some of the stone-fruits. In many orchards it ruins nearly the whole crop. "Wormy" apples, most of which are caused by this insect, have been mentioned in agricultural writings as far back as the time of Cato, nearly two hundred years before the Christian era. The insect is now a cosmopolitan pest, occurring in nearly every corner of the globe where apples are cultivated. It doubtless appeared

in America some time before 1750, and now occurs in nearly every apple-growing section.

The codling-moth appears in the spring about the time the blossoms are falling from apple trees, and after a few days glues its tiny scale-like eggs (Fig. 246) on to the skin of the young fruit, or even the adjacent leaves, where they hatch in about a week. The little apple-worm usually finds its way into the blossom-end, where it takes its first meal and where it remains feeding for several days, finaly eating its way to

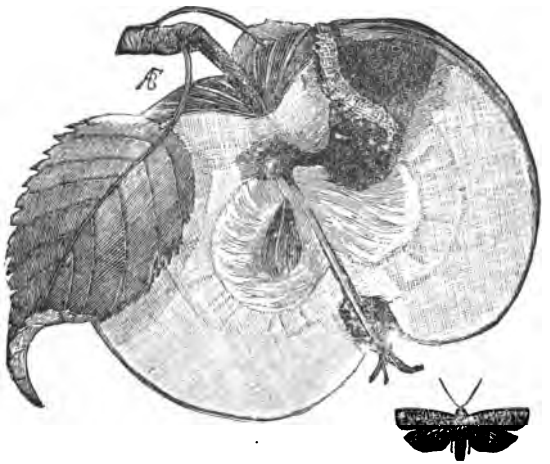


FIG. 243.—The Codling-moth, natural size. (From Lodeman's "Spraying of Plants," by permission of The Macmillan Company.)

the core (Fig. 243). In about three weeks it gets nearly full-grown and makes an exit tunnel to the surface, closing the outside opening of the tunnel for a few days while it feeds inside. Emerging from the fruit, it usually makes its way to the trunk of the tree, where it soon spins a cocoon under the loose bark. Usually the first worms thus to spin up in June or July soon transform to pupæ, from which the adult insect emerges in about two weeks, and eggs are soon laid on the leaves or the skin of the apples, from which a second brood of the worms hatches. In most of the more northern portions of the United States only a part of the worms of the first brood pupate or transform to moths the same season, but in the central, western,

and southern portions there is a complete second brood, and in some portions possibly even a third brood of the worms annually. In the fall all the worms spin cocoons wherever

FIG. 244.– Just the Time to Spray for the Codling-moth.

FIG. 245.—Calyx Cup Nearly Closed.

they may be, either in the orchard or in storerooms, and remain curled up in them as caterpillars until spring opens, when they transform, through the pupa, to the moth (Fig. 243), thus completing their yearly life-cycle.

No panacea for the codling-moth has yet been found, but by thorough work with a Paris green spray one can often save at least 75 per cent. of the apples that would otherwise be ruined by the worms. Where two or more broods of the insect occur during the season, as in Kansas, Nebraska, Oregon, New Mexico, and neighboring localities in the West, and in the South, the poison spray is not so effective, for, although 75 per cent. of the first brood of worms may be killed with

FIG. 246.—Calyx Cup Closed and too Late to Spray Effectually (note the tiny egg on skin of apple).

the spray, the few worms left will form a sufficient nucleus for a large and very destructivve second or third brood; in these localities the best that can be advised at present is to supplement the poison spray with the old banding system.

Various methods of trapping the worms when they are about to spin their cocoons have been practised with some degree of success. The most simple and as effective as any is to wrap a band of straw, or two or three folds of old burlap around the trunk of the tree. Put on the bands about the middle of June and examine and destroy the cocoons found in them every ten days until about September 1st when they need not be examined again until after the fruit is gathered.

To use the poison spray the most effectually one must understand that it is necessary to fill the blossom-end of each apple with poison within a week after the blossoms fall, for this is where the little apple-worm gets its first few meals, and it is practically our only chance to kill it with a spray. Watch the developing fruit after the petals fall, and be sure to apply the poison before the calyx lobes close (as shown in Figs. 244 and 245), for while *the falling of the blossoms is the signal to begin spraying, the closing of these calyx lobes a week or two later is usually the signal to stop spraying.*

The Pear Psylla (*Psylla pyricola*), one of the jumping plant-lice, has recently attained first rank as a pear pest in the eastern United States, and it occurs westward to the Mississippi River. It attacks only the pear-tree and has nearly ruined some pear orchards in New York; trees of all ages and varieties are attacked. Most of the damage is done by the nymphs (Fig. 248), which are only about one-tenth of an inch in length, but they often appear in incredible numbers, and congregating in the leaf-axils or on the fruit stems they soon sap the life of trees to such an extent that but little growth is made and the fruit sometimes drops when half-grown. The nymphs secrete large quantities of a sweet, sticky liquid, called "honey-dew," which spreads over the branches and leaves, sometimes even dripping from the trees. All through this honey-dew a black fungus grows, so that the bark of badly infested trees has a black, sooty appearance; this is usually good evidence at any time of the year that a pear-tree has suffered from the psylla. The adult insects (Fig.

247) are active creatures, quickly jumping and flying out of reach when approached; they feed, but not enough to do noticeable damage.

The insect hibernates in the adult stage, hidden in the crevices under the loosened bark on the trunk and large limbs of the pear trees. During warm days they often crawl about on the branches and trunk. They are not easily seen as they are so small, and their color so closely imitates the bark. In

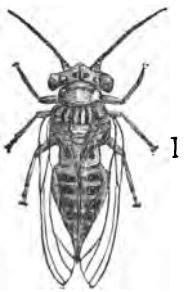


FIG. 247.

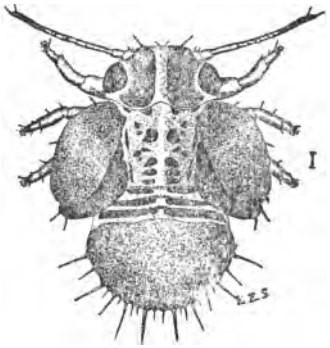


FIG. 248

The Pear Psylla. Adult and nymph, much enlarged.

April these adults lay their curious, orange-yellow eggs in the creases of the bark about the bases of the terminal buds of the preceding year's growth. By the middle of May, or about the time the first leaves are expanding, most of the eggs have hatched, and the little nymphs are at work sucking out the life of the tree. In about a month these nymphs have developed into adult psyllas, which are smaller than those which hibernated, and they soon lay eggs on the leaves for another brood. At least four broods of the insect develop in a season in New York and probably five in Maryland. Many pear-trees are so much weakened by the drain of so many little pumps sucking the sap that they do not have enough vitality to survive the winter. The insect is thus both a serious menace to the tree and to the crop of fruit.

It is very important that this pest should be checked early in the season, as the psyllas can be more easily hit with a

spray then, and every member of the first brood that is killed greatly reduces the numbers of the following broods. In badly infested pear-orchards it would pay to drench the bark of the trees in winter with a spray of whale-oil soap, dissolving about one pound in two or three gallons of water, and to each hundred gallons of this add ten gallons of crude petroleum. With this spray, or with a kerosene-water pump, using 30 or

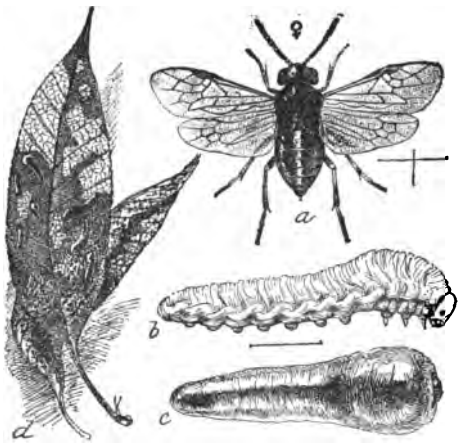


FIG. 249.—The Pear Slug. *a*, Adult saw-fly; *b*, slug with slime removed; *c*, same in normal state; *d*, infested leaves, natural size; *a*, *b*, *c*, much enlarged. (U. S. Div. of Entomology.)

40 per cent. of kerosene, most of the hibernating psyllas could be killed, and thus the pest be checked for the coming season. The nymphs and many of the adults can be killed in summer by thorough work with a spray of whale-oil soap, one pound in five gallons of water, or with a kerosene-water pump, using about 10 or 15 per cent. of kerosene. Sometimes the nymphs become covered with honey-dew, and it is difficult to hit them with a spray. Hence, just after a hard shower is a good time to make the application, as much of the honey-dew will be washed off. Prompt and thorough work in May or early June on the first brood is necessary if one is to control this pest. It is a very difficult matter to check it if it is let alone until later in the season.

The Pear or Cherry Slug (*Eriocampoides limacina*).—This

European pest has now made its way into practically every civilized country. It is one of the saw-flies, the adult (Fig. 249 *a*) being glossy-black and not quite so large as a house-fly. These flies emerge from the ground in May and insert their eggs into the tissues of the leaves from the under surface. The eggs hatch in about two weeks. The dark green larvæ (Fig. 249 *b c*) are snail-like in form, and their body is covered with a slimy olive-colored liquid; these characteristics have given them the popular and apt name of "slugs." The slugs feed on the upper surface of the leaves, skeletonizing them, as shown at *d* in Fig. 249.

Although very sluggish in movement, the slugs have an enormous appetite, and often do much damage, especially to young trees. They get their growth in about twenty-five days, go into the ground, and there transform in about two weeks to the saw-flies. A second brood of slugs results in August from eggs soon laid by these flies.

This is a very easy pest to control. The old method was to dust ashes, lime, or road-dust onto the slimy slugs, and it was sometimes quite effectual; but many of the slugs would simply moult off their dusted skin and thus escape. They feed so openly on the upper surface of the leaves that a dose of poison can be easily included in their menu. Dust on some hellebore if only a few young trees are infested, or spray infested trees with Paris green or some similar poison at the rate of one pound in one hundred and sixty gallons of water, or use it in Bordeaux mixture.

The Pear Midge (*Diplosis pyrivora*).—This insect was apparently introduced into America from Europe about 1877, being first noticed in Connecticut. It has slowly spread into the near-by States, and has become in many localities the most destructive enemy to the fruit of pear; it attacks no other fruit.

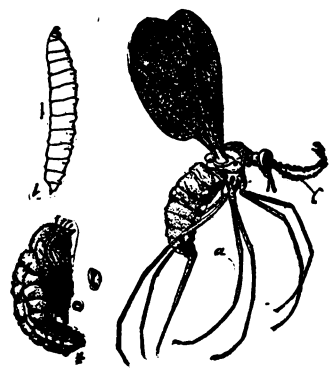


FIG. 250.—The Pear Midge. *a*, Adult; *b*, maggot; *c*, pupa; all much enlarged. (Adapted from Riley.)

The adult insects, which resemble miniature mosquitoes (Fig. 250 *a*), emerge from the soil beneath the trees early in the spring when the blossom-buds are just bursting. Before the blossoms get open, the little flies or midges insert their long

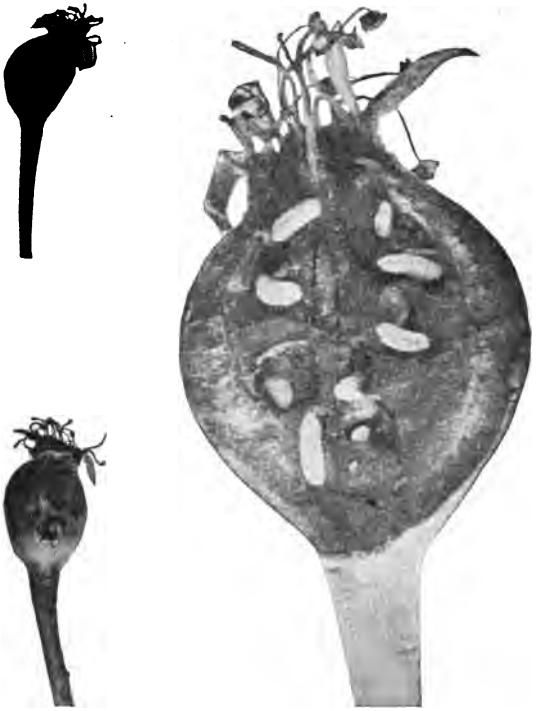


FIG. 251.—Work of the Pear Midge. Section of pear showing maggots at work, enlarged; an infested, misshapen fruit; fruit from which the maggots have emerged, natural size.

ovipositor through the closed petals and calyx and lay a dozen or more eggs on the anthers of the flowers. The eggs hatch in four or five days, and the orange or reddish-colored maggots (Fig. 250) enter the open ovary of the embryo fruit, where they feed upon the growing tissues, usually destroying the core and seeds and causing the young fruits to become dwarfed and misshapen, as shown in Fig. 251. The maggots get their growth about June 1st and remain in the fruit until a rain or

other moist conditions cause a rapid decaying and a cracking open of the infested fruit, as shown in Fig. 251. Through the openings thus made the maggots emerge and enter the soil an inch or two, where they make oval, silken cocoons, in which they remain until spring, when they change to pupæ, and soon afterward to the adult flies or midges.

The Lawrence variety of pear, which blooms early, seems to be a favorite with the midge.

The pest seems to be invulnerable to any insecticidal operation, which does not involve the loss of the fruit, until the maggots leave the fruit and enter the ground. Where only a few trees are infested, one could readily distinguish most of the infested, misshapen fruits, and pick them off and destroy them; this should be done before May 15th to be effective. It would pay in certain cases thus to destroy all the fruits on a few trees for a season if an orchard could be thereby freed from the pest.

Experiments give considerable hope that many of the midge maggots can be destroyed in loose sandy soils by an application of kainit, at the rate of one thousand pounds to an acre, about the middle of June. Other experiments on clay soils indicate that such heavy applications of potash salts each year injure the trees, and that thorough cultivation is far preferable to the fertilizers.

The Plum Curculio (*Conotrachelus nenuphar*).—This native American insect is the cause of most "wormy" plums, prunes, apricots, peaches, nectarines, and cherries. It is usually by far the most destructive insect with which growers of these fruits have to contend, as it often ruins the whole crop unless promptly checked. It also breeds in apples and pears, but not so freely as in the stone-fruits; during years when the latter fruits are a light crop it often becomes a serious pest on apples. The insect is widely distributed throughout the country east of the Rocky Mountains, but has not yet invaded the Pacific Coast States.

The adult insect (Fig. 252) belongs to a family of beetles known as curculios, weevils, or snout-beetles. It is a small, rough, blackish beetle, about one-fifth of an inch long, with a black, shining hump on the middle of each wing-case, and behind this a band of dull ochre-yellow color, with some

whitish marks near the middle. These curculios hibernate in any sheltered location, as in hedge-rows, rubbish piles, old stone-walls, or a near-by forest; in consequence of this, fruit-growers often notice that the portion of their orchard nearest

FIG. 252.—The Plum Curculio. Adult; larva; pupa; all enlarged.

such places suffers the most from the insect. The curculios come from their hiding places soon after the fruits are set, or when they are not larger than peas, and soon egg-laying begins.

This is an interesting operation. Alighting on a fruit, the mother beetle, with her jaws, which are situated at the end of the long snout, makes a small cut through the skin of the fruit and runs her snout obliquely into the flesh just under the skin and gouges out a cavity large enough to receive her egg. Then turning around, an egg is dropped into the hole, and again turning, she pushes it into the cavity with her snout. Just in front of this hole the mother now deftly makes a crescent-shaped slit (Fig. 253), which she extends obliquely underneath the egg-cavity so as to leave the egg in a sort of a flap of flesh, apparently her object being to prevent the growth of the fruit from crushing her very tender egg. This whole operation requires about five minutes. One female is said to deposit from fifty to one hundred eggs—a few each day. One

FIG. 253.—The Plum Curculio's Crescent Mark on a Cherry, natural size.

can readily see the eggs with the naked eye by carefully removing the skin of the fruit behind the crescent cut. The eggs hatch in from three to seven days, and the little white grubs burrow into and feed upon the flesh around the stone for about a month.

Infested fruits, cherries excepted, usually fall to the ground before the grubs mature. When full grown (Fig. 252 . the

FIG. 254.—A Cart Curculio-catcher in Operation.

white, footless grubs leave the fruits, burrow into the soil for three or four inches, where they form a little earthen cell, in which they soon change to white pupæ (Fig. 252). In from three to six weeks the pupæ transform to the curculios which emerge from the soil in July and August or later, and perhaps feed a little before seeking a place to pass the winter. There is thus but one brood of the insect in a year, although the curculios which "sting" or lay their eggs in the young fruits in the spring are developed and emerge from the soil during the latter part of the preceding summer.

The curculio travels by flying, but only during quite warm weather, or in the heat of the day. The insects mostly confine themselves to certain trees. But the fact that newly bearing and isolated orchards are soon attacked clearly shows that in occasional instances they must travel considerable distances. Indeed, they have been known to be wafted on the wind for a half-mile or more, the windward side of orchards being most infested immediately after strong winds from a thickly planted plum neighborhood.

Their flight appears to be never more than a few feet from the ground, and successful attempts have been made to shut them out of fruit gardens by means of a tight board fence, nine or ten feet high, entered by a tight gate.

The remedial measures suggested for the curculio are various. Those which merely repel without destroying the insect, and which are consequently inefficient, including such as spraying the young fruit with tobacco or lime-wash, or applying salt, offensive odors, etc. If practicable, avoid setting fruits liable to attack from this insect near woods, hedges, or other places where it can easily find such good shelter during the winter. As infested fruits, except cherries, often drop before the grubs mature, the gathering and destruction or feeding to stock of all fallen fruits daily will materially aid in reducing the numbers of the insect. It has been found that if swine are allowed to run in infested orchards, or where the trees are grown in poultry yards, good crops are often secured.

Several years ago it was discovered that the adult insects did considerable feeding both on the foliage and fruit of their food-plants. This led to extensive experiments in spraying with Paris green to kill the beetles, and the results were very encouraging, especially on cherry trees. Many fruit-growers now spray their trees two or three times, early in the season when the beetles are abroad, with Paris green or some similar poison at the rate of one pound in one hundred and sixty or two hundred gallons of Bordeaux mixture or water, and they are convinced of the effectiveness of the method so far as securing a profitable crop is concerned. Other extensive plum-growers claim that when the curculios are plentiful and there is not an abundant setting of fruits they have been unable to save the crop by spraying, and hence have discarded this

method altogether. Theoretically the poison spray should kill many of the curculios, for there can be no question about their feeding habits, as any one can soon convince himself by confining several in a box with fresh fruits or leaves.

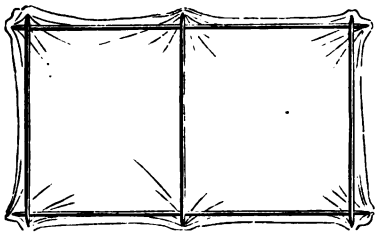


FIG. 255.—Thomas' Simple Curculio-catcher.

Many who have been fighting this pest for years are satisfied that the *jarring method* is the only way to circumvent it. Apparently this method was first proposed by David Thomas, the father of the author of this volume. In a communication to the *Genesee Farmer*, in 1832, he said: "Not three days ago I saw that many of the plums were punctured, and began to suspect that *shaking* the tree was not sufficient. Under a tree in a remote part of a fruit-garden, having spread the sheets, I therefore made the following experiment: On *shaking it well* I caught *five* curculios; *on jarring it with the hand* I caught *twelve* more; and on *striking the tree with a stone, eight* more dropped on the sheets. I was now convinced that I had been in an error; and calling in the necessary assistance, and using a hammer to jar the tree violently we caught in less than an hour more than two hundred and sixty of these insects."

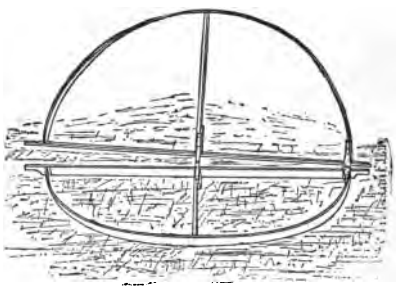


FIG. 256.—Goff's Circular Frame for Curculio-catcher. (After Goff.)

Several contrivances have been proposed for spreading sheets under the trees on which to jar down curculios for the purpose of killing them. Thomas found nothing better, and none so cheap and quickly made, as the contrivance represented in Fig. 255. In Fig. 256 is shown a modern circular frame which can be made by any one handy with carpenter's tools. It should be about ten feet in

diameter for large trees. Cover the whole frame with the sheeting, after which cut it open along one of the wood strips to the centre, where a small hole is cut to accommodate the trunk of the tree. The free edge of the cloth flap thus formed is then tacked to a light strip of wood of sufficient width so that it will cover the seam formed by cutting the cloth and rest by its own weight on the frame beyond.

In extensive Eastern orchards a wheelbarrow "curculio cart or catcher" (Fig. 254) is much used. It is not found necessary, as was formerly advised, to insert iron spikes into the trees or to leave short stumps of limbs on which to strike when jarring the trees. Long-handled mallets with the head well padded answer every purpose and do not noticeably injure the bark of the trees.

The best time for jarring is in the cool of the morning, when the insects are partly torpid with cold, and drop quickly. At mid-day they retain their hold more tenaciously, and more quickly escape. The work should be commenced very early in the season, as soon as the first fruit begins to set, or is not larger than a small pea. It may be necessary to continue the work every day for three or four weeks in some seasons. Usually the cost of jarring trees in this manner a season is from 10 to 20 cents per tree, which is a small amount to expend to ensure a crop worth many times as much. After being captured on the sheets, the curculios may be destroyed by throwing them into boiling water, into kerosene, or some burn them in small charcoal furnaces. A few minutes' work is often sufficient for many trees, and labor equal in the aggregate to that of a single entire day may save large and valuable crops.

The Plum Gouger (*Coccotorus scutellaris*).—In the northern portion of the Mississippi Valley this insect is often equally as destructive to plums as the plum-curculio, which it closely resembles. The female gouger deposits her eggs in the young fruit, making a round hole, but no crescent cut, and the grub feeds upon the kernel of the pit, in which it also transforms to the beetle. The rest of its life-story is much like that of the plum-curculio.

Poisonous sprays do not seem to check it, but otherwise it

is amenable to the same remedial measures as the plum curculio.

The Black Peach Aphis (*Aphis prunicola*) is a brownish-black plant-louse (Fig. 257) infesting the leaves, twigs, and roots of peach-trees. Trees less than three or four years old suffer most from its ravages. Thousands of such trees have been killed by it in Eastern peach-growing districts, and the pest has invaded Northern orchards.

FIG. 257.—The Black Peach Aphis, wingless form, much enlarged.

Peach stocks should be carefully examined before setting, and if there are any indications of plant-lice on them, they should be dipped in a strong kerosene emulsion or whale-oil soap solution. It is a difficult matter to destroy the lice on the roots after the tree is set. Tobacco dust well worked in around the base of the trees has given relief in some cases. The lice which work on the tree above ground can be killed with a spray of kerosene emulsion diluted ten or twelve times or with a kerosene-water mixture containing 15 per cent. of kerosene.

The Peach-tree Borer (*Sanninoidea exitiosa*) "has killed more peach trees than all other causes combined," says J. H. Hale. It is an American insect and has been a serious menace to peach-growing for more than a hundred years. It sometimes also attacks plums, prunes, cherries, apricots, and nectarines, and has to be fought by nearly every peach-grower.

The borer is a white, grub-like caterpillar (Fig. 258 *c*), which feeds on the inner bark, forming a tunnel or burrow, usually on the trunk or large root below the surface of the soil. Infested peach trees are easily distinguished by the large mass of a gummy substance exuded from the wound and mixed with particles of bark and excrement. The adult insect is a beautiful, blue, wasp-like moth, the male (Fig. 258 *b*) differing remarkably from the female (Fig. 258 *a*).

In the latitude of New York the moths begin to appear in the latter part of June and continue to emerge until September. A few hours after emerging the females lay their small,

oval, brown eggs on the bark of the trunks of the trees from six to eighteen inches from the ground. From the egg there hatches in a week or ten days a minute larva—the young borer—which at once works its way into a crevice of the bark, and soon begins feeding on the inner layers of the bark. It continues to feed in this manner, gradually enlarging its burrow under the bark, until winter sets in, when it stops feeding and hibernates during the winter, either in its burrow or in a thin hibernaculum made over itself on the bark near the surface of the soil. The winter is always spent as a larva or borer, a few of them being nearly full-grown, but most of

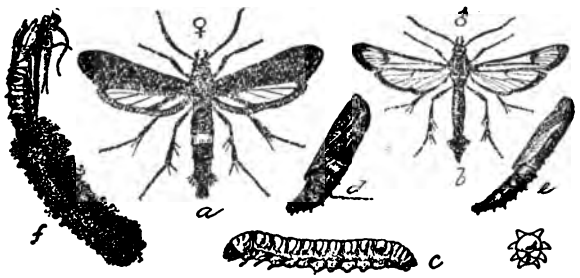


FIG. 258.—The Peach-Tree Borer. *a*, Female moth; *b*, male; *c*, full-grown larva; *d*, female pupa; *e*, male pupa; *f*, cocoon with pupa skin partially extended; all natural size. (U. S. Div. of Entomology.)

them being considerably less than one-half grown. In the spring, usually about May 1st in New York, they break their winter's fast and grow rapidly for a month or more, most of them getting their full growth in June. They then leave their burrows and spin about themselves a brown cocoon (Fig. 258*f*) at the base of the tree, usually at the surface of the soil. A few days after its cocoon is made the borer changes to a pupa (Fig. 258 *d*, *e*), in which stage it remains for about three weeks, usually in June in New York. From the pupa the moth emerges, thus completing its life-cycle in a year, fully ten months of which are usually spent as a borer in the tree, the remainder or a little more than a month being spent in the egg, pupa, and adult stages. About the middle of July all stages of the insect may be found in some orchards. The above brief sketch of the life of the peach-tree borer will apply

in general to most localities in the United States north of Washington, D. C. In Canada the moths do not begin to fly until about a month later, while in the South they appear a month or more earlier, so that the dates in the above sketch will not apply to these regions.

The insect is open to successful attack only in its larva or borer stage, and in its pupa stage; the pupæ are reached only by searching for the cocoons and destroying them.

FIG. 259.—Work of a Single Borer in a Peach-tree, natural size. *w b*, Burrow of borer; *g*, gummy mass; *p*, pupa projecting from cocoon.

After four years of careful experimenting with most of the methods recommended to control this pest, we are led to the following conclusions:

The "digging out" method is the only thoroughly successful and safe way of killing the peach-tree borer. This method is expensive in time and labor, but our experience leads us to believe that any other equally as successful method will cost just as much. To make it a success the "digging out" should be thoroughly done, not only on every tree in the orchard, but also on all "old relics" of peach-trees in the immediate neighborhood. A half-dozen such "old relics" left untreated near by will serve thoroughly to restock an orchard with borers every year, so that the "digging out" method, although practised each year, will never reduce the numbers of the borers below the danger limit.

This is a very important factor in the success of the "digging out" method. Dig out the borers in June or in June and September in northern peach-growing districts.

We kept out about two-thirds of the borers with tobacco stems wound around the tree just below the surface of the soil. The old "mounding" method evidently has considerable value as a preventive, and is, perhaps, the cheapest method yet devised. It is the most practicable method yet suggested for combating the insects in nurseries. Paper protectors, when carefully put on and kept intact during the danger period, will prove a valuable and very cheap preventive measure, especially when combined with the "digging out" method. Wooden boxes or wire cages did not prevent the entrance of the borer.

The favorite method of preventing the ravages of the peach-tree borer has been, for at least a century, by the use of a *wash* of some kind. More than fifty different washes have been concocted, most of which are valueless as preventives, and some of which will injure or kill the trees. Soap, lime, or clay proved useless ingredients of washes in New York's climate. Paris green did not add to the effectiveness of a wash, and is a dangerous ingredient to use on a tree. Carbolic acid or other odorous substances did not repel the insect.

Gas tar proved to be the best application we tested. We used it freely on the same trees for three successive years without the slightest injury to the trees, and it kept out nearly all the borers. Go slow with it, by first testing it on a few trees in your orchard, as trees have been killed with it. We believe it will prove equally effective whether the borers are dug out or not, and from no other application yet devised would we expect to get such results when used independent of the "digging out" method.

The following substances injured or killed our young trees, and are, therefore, classed as *dangerous:* Paris green and glue, raupenleim, dendrolene, white paint (with or without Paris green), and printer's ink.

The following is a list of the things we found to be practically *ineffectual* or *useless:* Wire-cages, carbon bisulphide, asafœtida and aloes, lime, salt and sulphur, resin wash, hard

soap, tallow, tansy plant, whale-oil soap, lime and linseed oil, hydraulic cement wash, pine tar, and one application of Hale's wash.

The following methods proved to be *quite effective*—that is,

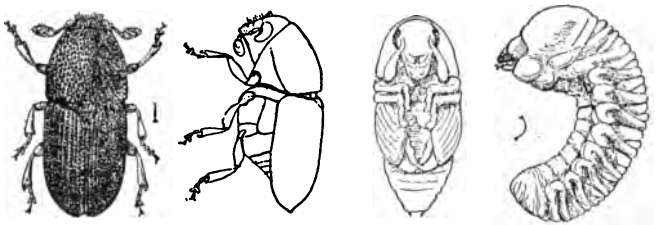


FIG. 260.—The Fruit-tree Bark-beetle. *a*, Beetle; *b*, same in profile; *c*, pupa; *d*, larva; all enlarged about ten times. (U. S. Div. of Entomology.)

most of them kept out over one-half of the borers: Hale's wash (two applications), mounding, tarred paper, tobacco stems, digging out, and gas tar.

FIG. 261.—Work of the Fruit-tree Bark-beetle in Twig of Apple, natural size. (U. S. Div. of Entomology.)

In regions less moist than in Central New York it is possible that some of the methods, listed above as unsatisfactory, will prove good preventives against this serious pest. Washes should be applied about June 15th in Northern orchards, and must remain intact for over two months.

The Fruit-tree Bark-beetle or Shot-hole Borer (*Scolytus rugulosus*).—The bark of plum, peach, cherry, and apple-trees may appear thickly "peppered" with holes, as though by fine bird shot (Fig. 261). These are the entrance and exit holes of a small beetle (Fig. 260 *a*) whose grubs (Fig. 260 *d*) excavate narrow galleries in various directions under the bark, and often kill the tree or some of its branches. Usually only sickly or unthrifty trees are attacked by the insect.

It is a very difficult insect to combat. Badly infested trees should be burned at once. Keep the trees in good health and they will

be less liable to attack. Deterrent washes have not been very successful; probably applications of kerosene-water, tar, or crude petroleum would be as helpful as anything.

The Cherry Aphis (*Myzus cerasi*) is a blackish plant-louse which often appears on the leaves of cherry-trees in immense numbers, causing the leaves to curl badly. It often checks the growth of the trees, and is sometimes a serious pest in nurseries. It winters over on the twigs as minute black eggs. "Lady-bugs" and other enemies often aid materially in checking its injuries. It will succumb to the same remedial measures as the apple-aphis; it is important to spray early in the season before the leaves are so badly curled that one cannot readily hit the lice.

The Cherry Fruit-fly or Maggot (*Rhagoletis cingulata*) is a new fruit pest which has recently appeared in the cherry orchards of New York and neighboring States. It is closely allied to the apple maggot, and has a similar life-history. It has ruined from one-third to one-half of the crop in some orchards. It will prove a very difficult pest to control, for infested fruits do not drop from the tree, nor do they show any external evidences of their being inhabited by a maggot until they are overripe. Cherry-growers should be on the lookout for this new enemy. No successful remedial measure has yet been found.

The Quince Curculio (*Conotrachelus cratægi*), as its name indicates, is a near relative of the plum curculio. It is the cause of most "wormy" and "knotty" quinces, and often mars or nearly ruins much of the crop. The beetle resembles the plum curculio, except it is broader just back of the head, and has no humps in its back. It lays its egg in a pit in the flesh and makes no crescent slit, and it also differs much in its life-history, as it winters in the grub stage in the soil.

This quince pest can best be controlled by the jarring method, as described for the plum curculio. As quince trees are usually branched much lower than plum trees, it will be nceesary to use lower "curculio-catchers" in collecting quince curculio.

The Grape Phylloxera (*Phylloxera vastatrix*) is a small plant-louse, one form of which works on the roots, causing excrescences on the smaller roots, and eventually killing suscepti-

ble varieties (Fig. 262); another form of the insect works on the leaves, forming irregularities on the under sides. The insect has always existed on American wild vines, yet it was not until it had been introduced in Europe, where it has wrought incalculable damage, that it attracted attention as a vine pest. It rarely does serious damage in this country, except in California, where European vines are grown.

"The use of American vines, either direct for the produc-

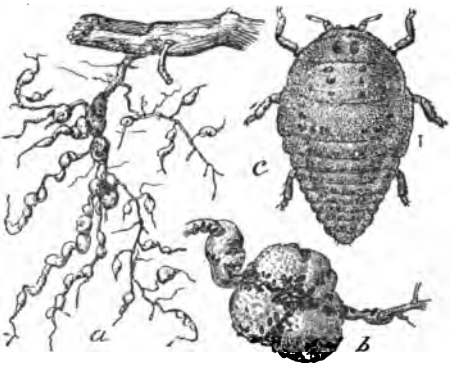


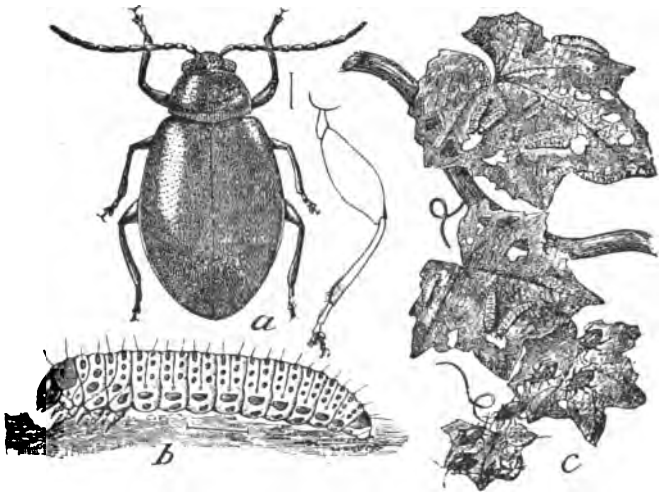
FIG. 262.—The Grape-vine Phylloxera. *a*, Root-galls; *b*, enlargement of same, showing disposition of lice; *c*, root-gall louse, much enlarged. (U. S. Div. of Entomology.)

tion of fruit or as stocks on which to graft susceptible European and American varieties, has practically supplanted all other measures against the insect in most of the infested vineyards of the world."

Grape-vine Flea-Beetle (*Haltica chalybea* (Fig. 263).—This is a small shining beetle about one-sixth of an inch long, usually of a steel-blue color, but often varying from green to purple. Many grape-growers have awakened some morning to find all of their prospective crop of grapes literally "nipped in the bud" by this pest. It has recently thus devastated hundreds of acres of vineyards in the great grape-growing regions of New York. Sometimes the insect apparently attacks a certain variety in preference to others, and it also works on the Virginia creeper.

After the beetles have satisfied their appetites, keen from

their long fast in hibernation, on the opening grape buds, they then lay their yellow eggs in the crevices around the buds. From these eggs hatch small brown grubs which eat irregular holes in the leaves (Fig. 265) in June. These grubs (Fig. 264) go into the ground and transform to the pretty blue beetles in about ten days. The beetles emerge and feed upon various plants during the rest of the season, but lay no eggs



FIGS. 263, 264. FIG. 265.

The Grape-vine Flea-beetle.

FIG. 263.—Beetle. FIG. 264.—Larva. FIG. 265.—Beetles and larvæ at work on leaves, natural size. Figs. 263 and 264 much enlarged. (U. S. Div. of Entomology.)

for another brood of grubs until the next spring. They hibernate in any sheltered place around the vines.

This serious pest of the grape-growers can be easily controlled by the thorough use of a poison spray on the bursting buds in early spring; use Paris green at the rate of one pound in fifty to seventy-five gallons of water, to which two pounds of freshly slaked lime are added, and be sure not to let the beetles get the start of you in the spring. Or the beetles may be jarred from the buds into pans of kerosene, or on to sheets soaked in kerosene; the beetles quickly drop when the vine

is jarred. Follow up this treatment in the early part of June by spraying the infested portions of the vines with Paris green (one pound to one hundred and fifty gallons of water) to kill the grubs then feeding on the upper surfaces of the leaves; every grub killed then means one less beetle to hibernate and attack the buds the next spring; it is thus very important to kill these grubs in June.

The Rose-Chafer or "Rose-bug" (*Macrodactylus subspinosus*).— This beetle suddenly appears in great numbers in portions of the country, and in occasional years proves exceedingly destructive to the flowers and foliage of various plants, more particularly of the rose, apple, and grape.

It is an awkward, long-legged, light-brown beetle (Fig. 266) about a third of an inch in length. By the end of July the unwelcome hordes often disappear as suddenly as they came. The insect is particularly destructive in New Jersey, Delaware, and in sandy regions in New York and neighboring States. Its early stages are passed in grass or meadow land, usually where the soil is sandy. The grubs feed on the roots of grasses. The beetles lay their eggs in the ground in June and July, and the grubs get their growth by autumn, and transform to pupæ, and then to beetles the following spring.

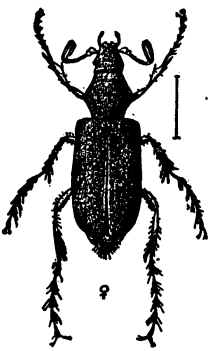


FIG. 266. — The Rose-Chafer, enlarged.

It is a most difficult pest to control or kill, as they sometimes come in hordes of thousands. Substances applied to the vines to render them obnoxious to the beetles have proved of little value. The arsenicals usually will not kill them quickly enough or in sufficient numbers noticeably to reduce their ranks. When they come in swarms, the only hope is in collecting them in nets or in an inverted umbrella-shaped apparatus provided with a vessel of kerosene and water at the bottom to wet and kill the beetles. A few valuable vines or trees could be covered with netting to protect them. Their numbers may be considerably reduced, especially where they are a local pest over a limited area, by devoting their breeding grounds, usually a sandy locality

near by, to the growth of annual crops which require frequent cultivation.

The Grape-vine Leaf-hopper (*Typhlocyba comes*).—When grape leaves have a blotched appearance, or are covered with little yellowish or brownish patches, as at *f* in Fig. 267, and eventually dry up and fall, it is usually the work of little jumping insects, called leaf-hoppers (Fig. 267). They are minute insects about an eighth of an inch in length, and have a peculiar habit of running sidewise when disturbed, and dodging to the

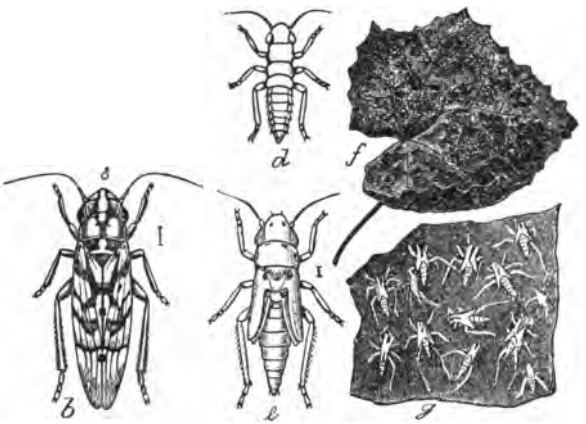


FIG. 267.—The Grape-vine Leaf-hopper. *b*, Adult; *d* and *e*, nymphs; *f*, work of insect on leaf; *g*, cast skins of nymphs on leaf; *b*, *d*, and *e*, much enlarged. (U. S. Div. of Entomology.)

other side of the leaf. The adults jump or fly away quickly when the vine is disturbed. Their wings and back are variously colored with red, yellow, and brown, while the body color is light yellowish-green. In May they begin to appear, and continue on the vines until the leaves fall. The adult hoppers spend the winter in masses of rubbish or leaves accumulated against fences or other obstruction, where thousands of them may be seen on warm winter days. The eggs are thrust under the skin of the lower side of the leaves of the vine in June. The nymphs (Fig. 267 *d* and *e*) live on the under sides of the leaves and suck out the substance of the leaf. As the nymphs grow they shed their skins four times,

and the empty skins often remain attached to the leaves in large numbers (Fig. 267 *g*). The nymphs run rapidly but do not jump like the adult hoppers. Apparently there is but one full brood annually in New York. All varieties of grapes are attacked, but the thin-leaved sorts suffer the most.

The adult hoppers are so active that it is difficult to hit them, and insecticides that will kill them damage the vine leaves. We have killed many adults in June by knocking them off and down to the ground with a 5-per-cent. kerosene-water spray and then quickly hitting them on the ground with a 25-per-cent. kerosene-water spray. Another practicable method is to catch them on sticky shields. Make a shield by stretching a cloth over a frame and treat it with tar or resin and castor oil ("tanglefoot"), then in the warm part of the day, when the insects are most active, carry the shield along near the vines and shake the vines. Thousands of them will fly or jump against the shield and be caught. Practise this every day or two until relief is gained. In July the nymphs or young hoppers quickly succumb to a spray of whale-oil soap (one pound in ten gallons of water), but it requires thorough and intelligent work to hit them on the under sides of the leaves.

Currant Borers often work considerable havoc by burrowing up and down the stems, usually killing them. There are two species of insects engaged in this nefarious work. One is the caterpillar of a moth allied to the peach-tree borer and known as the *Imported Currant Borer* (*Sesia tipuliformis*); the other species is the grub of a beetle known as the *American Currant Borer* (*Psenocerus supernotatus*). The two kinds have similar habits, and remain in the stems over winter. It is thus an easy matter to stop their depredations by cutting out and burning all sickly or hollow stems either in the autumn or early spring.

The Imported Currant Worm (*Pteronus ribesii*) must be seriously considered when one attempts to grow currants or gooseberries in most parts of the country; it defoliates millions of these bushes every year.

The adult insect is a pretty little yellow-bodied saw-fly (Fig. 268) which emerges from its cocoon in the soil in the spring when the first few currant leaves have expanded, and at once

proceeds deftly to place its white eggs along the principal veins on the under sides of the leaves. The eggs soon hatch into twenty-legged larvæ or "worms" of a green color, with black heads and numerous black dots on the body (Fig. 270). They are about three-fourths of an inch long when full grown. When, as usually happens, they occur in large numbers, the leaves are rapidly consumed, and whole rows of bushes have been entirely stripped in forty-eight hours. Hence the importance of close watching and prompt attention in applying the remedies to destroy them. A single defoliation, while it does not kill the bushes, retards growth, and commonly greatly

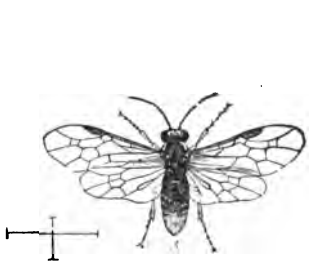


FIG. 268.—Male.

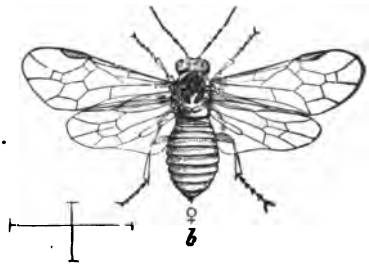


FIG. 269.—Female.

Adults of Imported Currant Worm.

injures or prevents the ripening of a crop. When the larvæ attain full size, they burrow underground, or hide under scattered leaves, and spin an oval brown cocoon. After some weeks the perfect insect comes out and lays eggs, from which a second brood may appear in Southern localities. The winter is passed as larvæ in their cocoons in the soil beneath the bushes.

Fortunately this currant pest is easily destroyed by the application of poisons. White hellebore has been the standard remedy for many years. It is either dusted on to the bushes or a water mixture of it sprayed on. It is the only safe thing to use after the fruit is over half-grown. But extensive currant-growers now use a Paris-green spray (one pound to one hundred and fifty gallons of water) freely when the larvæ first appear, and often so effectually destroy the first brood that the insect is not a serious menace to the crop during the rest of the season.

The Native Currant Worm (*Gymnonychus appendiculatus*) is now rarely seen on cultivated currants or gooseberries; hence need not be discussed here.

The Currant Spanworm (*Eufitchia ribearia*) (Fig. 271), is occasionally destructive to currants and gooseberries in certain localities. It is a bright yellow looping caterpillar with black spots, that hatches in the spring from eggs laid on the twigs in the fall by a pale yellowish moth with several dusky spots on its wings. Hellebore or Paris green, used as recommended for the green currant worm, will destroy these spanworms.

FIG. 270.—Imported Currant Worm —Larvæ.

The Raspberry-cane Borer (*Oberea bimaculata*) is sometimes a serious pest in raspberry and blackberry plantations. The adult insect is a slender dark-colored beetle, about one-half an inch long, and with a yellow thorax. The beetles appear in June, and the female with her mandibles makes two rows of punctures, about an inch apart, around the growing cane near the tip. She then deposits an egg in the cane midway between the punctures which serve to girdle the cane and cause it to droop and wither. The little white grub soon hatches from the egg, and proceeds to tunnel its way down the pith of the cane. Recent observations indicate that the grub lives in the cane for two seasons, often extending its tunnel down to the ground, where it transforms through the pupa stage to the beetle.

This borer is easily controlled by cutting off when first noticed all canes with drooping tips several inches below where they are girdled; this will destroy the young grubs. Later, when harvesting the fruit, the infested canes can often be detected by their sickly appearance or the drying of the

leaves; all such canes should be cut off near the ground and burned.

The Snowy Tree-Cricket (*Œcanthus niveus*) sometimes seriously injures raspberry canes by depositing its eggs in longitudinal rows in the canes, forming a long ragged scar, as

FIG. 271.

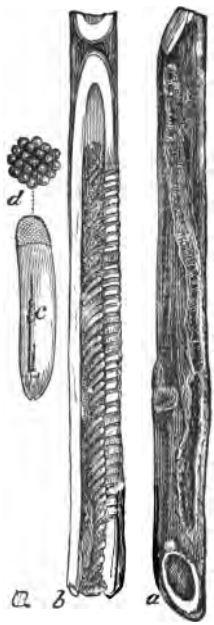


FIG 272

FIG. 271.—Currant Span Worm. FIG. 272.—The Snowy Tree-cricket. *a*, *b*, Stems of raspberry with eggs; *c*, *d*, egg, enlarged with details.

shown is Fig. 272. These eggs are laid in late summer or fall and do not hatch until the early part of the next summer. Except for the injury caused by the female in laying her eggs, this tree-cricket is not an injurious insect, but is said to feed upon plant-lice and other insects.

Canes containing these ragged slits full of eggs should be cut off and burned, especially in the fall and winter.

The Raspberry Saw-fly (*Monophadnoides rubi*) attacks the foliage of raspberries, blackberries, and dewberries, and often occurs in sufficient numbers nearly to ruin the crop. The

black-bodied, four-winged saw-fly emerges from its cocoon in the soil in May, and the female, with her saw-like ovipositor, inserts her eggs into the tissue of the under side of the leaf near the veins. The eggs hatch in from seven to ten days. Although the insect is closely allied to the common currant saw-fly, the larvæ differ remarkably in having their body profusely ornamented with spiny tubercles. When full grown in June, the larvæ of this raspberry saw-fly are about three-fourths of an inch long and are nearly the color of the raspberry leaf; the spines on the back are blackish and those on the sides pale green. They devour the whole leaf except the mid-rib and larger veins. During the latter part of June they enter the ground two or three inches and make an almost waterproof brown cocoon, in which they remain all winter, gradually changing through the pupa stage to the adult or saw-flies the next spring. There is thus but one brood of the larvæ each season.

The larvæ are easily jarred or shaken from the leaves, and some have reported success in controlling this pest on small areas by hiring boys and girls to jar off the little feeders by giving the canes light blows with a heavy, leafy switch, as a light pine branch with a bunch of needles at the end; the larvæ find it difficult to return to the bushes, especially if the ground between the rows be left well cultivated and crumbly, and if the jarring be done in the heat of the day.

An easier, cheaper and more effective method is to spray infested bushes with Paris green or some similar poison, using one pound in one hundred and fifty to two hundred gallons of water. One thorough application is sufficient to destroy most of the larvæ. After the fruit is more than half formed, use hellebore, either as a spray (one ounce to one gallon of water) or dusted on when the dew is on.

White Grubs (*Lachnosterna sp.*) (Fig. 273) are often a very serious menace to successful strawberry culture. They are the larvæ of the large brown beetles (Fig. 274), commonly known as May Beetles or "June-bugs." White grubs live upon the roots of plants, and their usual feeding grounds are grass lands. Hence, when strawberries are set on land which has been in sod for several years, it often follows that they are attacked by the grubs which had been living on the grass

roots. Affected plants present a peculiar wilted appearance, readily distinguished by the practised eye. The grubs feed during three seasons, finally transforming in the soil through the pupal stage (Fig. 275) to the May beetles early in the autumn; the beetles, however, remain in the soil and do not emerge until the next May or June. Most of the damage is done in strawberry beds by the nearly full-grown grubs.

The first precaution for the strawberry-grower to observe in trying to escape the ravages of white grubs is to avoid setting

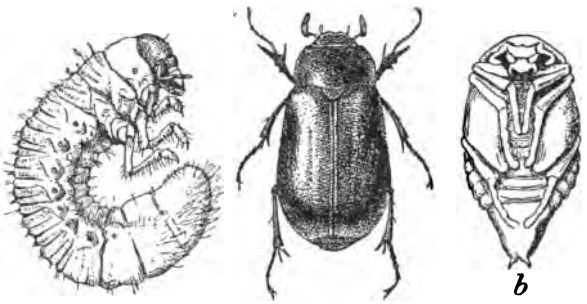


FIG. 273.—The Grub. FIG. 274.—Beetle. FIG. 275.—Pupa.
The White Grub and its Parent, the May Beetle. (U. S. Div. of Entomology.)

his plants on old sod lands. If this must be done, then plough and thoroughly pulverize or cultivate such soil in the fall, thus disturbing and killing many grubs, pupæ, and recently-formed beetles. It will also pay to stir the soil frequently before and after setting the strawberries in the spring or summer, as thorough cultivation is a great discourager of white grubs.

Salt or similar applications to the soil around the plants rarely give relief. Experienced strawberry-growers can usually detect an infested plant, and they often practise the sure and not difficult method of digging out the culprit; the relieved plant often pays for the trouble later on.

The Strawberry Root-louse (*Aphis forbesi*) is a very small greenish-black plant-louse which attacks the roots of strawberries. In Maryland, New Jersey, and Delaware, it is said that hundreds of acres of vines have been rendered valueless by these lice. The insect also occurs westward through Ohio, Illinois, and into Wisconsin. It is a comparatively new pest,

but it usually becomes a serious one wherever it gets thoroughly established, especially in light soils. The wilting of the vines, as if for want of water, is said to be an indication of the presence of the insect on the roots. One should dig up and carefully examine the roots of such wilted plants. If the insect is found, the most stringent measures should be taken to prevent its spread.

It is said to be accompanied by ants, which may spread it from plant to plant. It is spread into new localities on the roots of the plants sent out by dealers.

Thus far, no one has succeeded in devising a practicable method of killing the lice on the plants after they are set. Some claim to have been successful with tobacco dust, but others have failed. Badly infested fields had better be plowed under at once and other crops grown there for a year or more. The only sure way to avoid the insect is to buy plants entirely free from it (doubtless plants which had been properly fumigated with hydrocyanic acid gas would be safe to use), and then set them on land where the louse has never existed.

The Strawberry-crown Borer (*Tyloderma fragariæ*) is one of the most destructive strawberry insects in the Mississippi Valley. The adult insect is a small brown snout-beetle allied to the plum curculio. It cannot fly, as its wings are rudimentary. The female lays her eggs on the crown of the plant in the spring, and the thick, footless, white grub which hatches therefrom excavates the crowns during the summer. In its subterranean cavity the grub transforms to a pupa, and finally, in August and September, to the beetle, which emerges from the crown, and, after feeding on the leaves, hibernates in the strawberry field. Old fields are especially liable to injury.

As the beetles cannot fly, it is desirable to isolate the new plantations from the old ones. If new plants must be taken from an infested field, use those which started after July and dig them early in the spring, to avoid carrying the eggs or larvæ of the insect with the plants. The plowing under of the infested field about July 1st will destroy the insect. The frequent rotation of other crops with the strawberry patch usually prevents the ravages of this crown borer.

The Strawberry Leaf-roller (*Phoxopteris comptana*) is in many localities the most injurious insect pest of the strawberry. A small greenish or brownish caterpillar folds the leaflets of the strawberry by bringing the upper surfaces together and fastening them by silken cords (Fig. 276). In this retreat the insect spends its whole larval life, feeding upon the leaf, and ultimately causing it to turn brown and shrivel up. The transformation through the brown pupa to the adult insect—a pretty little brown moth—takes place within the folded leaf. There are two annual broods of the pest in the

FIG. 276.—Strawberry Leaves Folded by the Strawberry Leaf-roller.

North, and at least three in Kentucky and southward. The winter is passed as a pupa in the rolled leaves.

Spraying with poisonous mixtures is impracticable while there is fruit on the plants, and experiments indicate that such applications are not very effectual at any time, so securely protected are the feeding-grounds of the caterpillars.

However, it is claimed that the pest can be almost exterminated in a field by mowing it after the crop is gathered, and after leaving it a day or two to become dry, burn it over, perhaps with the aid of a little straw or rubbish. This can usually be done without the slightest injury to the plants. This will destroy the leaf-roller as well as several other kinds of insects,

and also the spores of some serious fungous diseases. On small areas it is practicable to crush by hand the insects in the rolled leaves.

The Strawberry Weevil (*Anthonomus signatus*) is a little snout-beetle, measuring only a tenth of an inch in length (Fig. 277), which deposits an egg in a strawberry bud and then punctures or cuts the stem below it (Fig. 278) in such a way that in a few days the bud drops to the ground. Within the severed bud the grub hatched from the egg develops and transforms to a pupa, and soon to the beetle, which hibernates.

FIG. 277.—Strawberry Weevil.

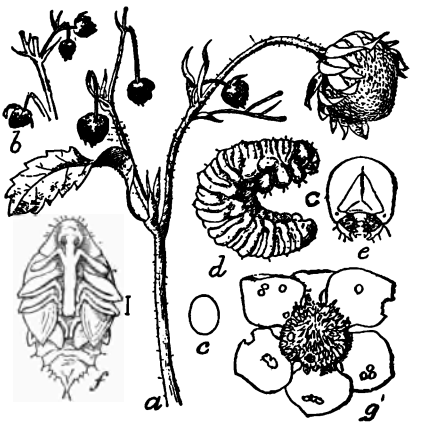


FIG. 278 —*a*, *b*, Strawberry spray, showing work in bud and stem, natural size; *d*, larva; *f*, pupa; *d*, *f*, much enlarged. (U. S. Div. of Entomology.)

The beetles often feed upon the pollen and petals of the flowers, but the insect never attacks the fruit or foliage.

This pest is widely distributed throughout the Eastern United States; Maryland and Virginia strawberry-growers have suffered severely, half the crop in the former State being destroyed in 1896, it is estimated. The insect restricts its work to the staminate varieties and to the pistillates which furnish a considerable quantity of pollen. It also attacks the buds of the wild strawberry, the blackberry, and the red-bud tree.

This weevil is an extremely difficult pest to control. Poisonous and other sprays have not thus far given very encouraging results. It would be practicable to cover small areas or valuable plants with a muslin protector, put on about a week before the first blossoms appear. Grow as few staminate plants as practicable.